

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
26 August 2004 (26.08.2004)

PCT

(10) International Publication Number
WO 2004/071646 A3

(51) International Patent Classification⁷: **B01D 53/94**,
F01N 3/20, C01C 1/02

(21) International Application Number:
PCT/US2004/004093

(22) International Filing Date: 11 February 2004 (11.02.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/446,780 12 February 2003 (12.02.2003) US
60/446,882 12 February 2003 (12.02.2003) US

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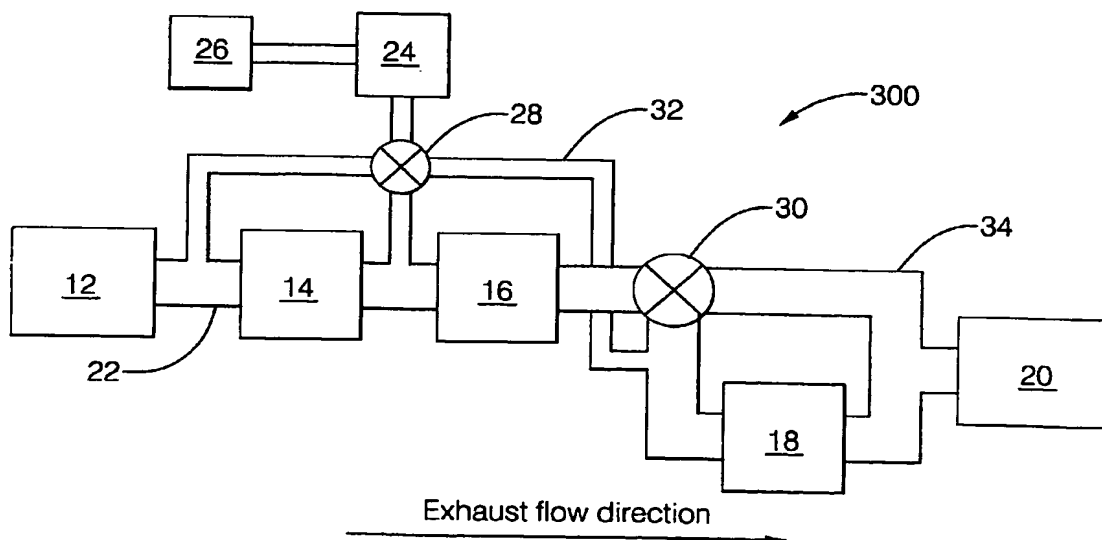
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

[Continued on next page]

(54) Title: SYSTEM AND METHOD OF NO_x ABATEMENT



(57) Abstract: A NO_x abatement system comprising: a first NO_x adsorber (18) capable of being disposed in-line and downstream of and in fluid communication with an engine (12); a selective catalytic reduction catalyst (20) disposed in-line and downstream of and in direct fluid communication with the first NO_x adsorber (18), wherein the selective catalytic reduction catalyst (20) is capable of storing ammonia; and an off-line reformer (24) disposed in selective communication with and upstream of the first NO_x adsorber (18) and the selective catalytic reduction catalyst (20), wherein the reformer (24) is capable of producing a reformat comprising primarily hydrogen and carbon monoxide.



(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) **Date of publication of the international search report:**
23 September 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/004093

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D53/94 F01N3/20 C01C1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D F01N C01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/100519 A (DAIMLER CHRYSLER AG ; GOERIGK CHRISTIAN (DE); DUVINAGE FRANK (DE); NOL) 19 December 2002 (2002-12-19) page 11, paragraph 2 - page 12, paragraph 1 page 14, paragraph 2 - page 16, paragraph 2; figures 2,4	1-40, 45-48
X	EP 1 023 935 A (DEGUSSA) 2 August 2000 (2000-08-02) column 2, line 39 - column 3, line 28 column 8, line 1 - line 40; figure 5 ----- -/--	34-40

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

16 July 2004

Date of mailing of the international search report

16/08/2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/004093

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/094420 A (SCHUETTE RUEDIGER ; DEGUSSA (DE); ENGLER BERND (DE); LANG JUERGEN (DE)) 28 November 2002 (2002-11-28) page 14, line 33 - page 15, line 18; figure 3	34-40
X	----- PATENT ABSTRACTS OF JAPAN vol. 0154, no. 57 (M-1181), 20 November 1991 (1991-11-20) & JP 3 194111 A (SHINNENSHIYOU SYST KENKYUSHO:KK), 23 August 1991 (1991-08-23) abstract	34-36
A	----- WO 00/76637 A (NISSELROOIJ PETRUS FRANCISCUS ; GASTEC NV (NL); BOUWMAN WILLEM HENDRIK) 21 December 2000 (2000-12-21) page 4, line 32 - page 5, line 2 page 6, line 28 - page 7, line 33 page 10, line 3 - page 11, line 15	1-48
A	----- US 2002/073692 A1 (KATASHIBA HIDEAKI ET AL) 20 June 2002 (2002-06-20) paragraph '0059! - paragraph '0062! paragraph '0078! - paragraph '0079! paragraph '0142! - paragraph '0148!	1-48
A	----- EP 0 773 354 A (TOYOTA MOTOR CO LTD) 14 May 1997 (1997-05-14) column 5, line 4 - line 12 column 8, line 29 - column 9, line 33; figures 1,4a,4b	1-48
A	----- WO 03/009925 A (BALLARD POWER SYSTEMS ; KEPPELER BERTHOLD (DE); SCHUERSTEDT PETER (DE)) 6 February 2003 (2003-02-06) page 3, line 3 - page 4, line 2; figure 1	1-48
A	----- DE 195 10 804 A (DORNIER GMBH) 26 September 1996 (1996-09-26) claim 7; figures 1,4	45-48
A	----- WO 01/14698 A (MASSACHUSETTS INST TECHNOLOGY) 1 March 2001 (2001-03-01) page 7, line 12 - line 20; figure 1	45-48

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/004093

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 02100519	A	19-12-2002	DE 10128414 A1 WO 02100519 A1 EP 1395351 A1	19-12-2002 19-12-2002 10-03-2004
EP 1023935	A	02-08-2000	DE 19903533 A1 EP 1023935 A1 JP 2000271447 A US 2001002244 A1	10-08-2000 02-08-2000 03-10-2000 31-05-2001
WO 02094420	A	28-11-2002	DE 10124548 A1 WO 02094420 A1 EP 1395352 A1	28-11-2002 28-11-2002 10-03-2004
JP 3194111	A	23-08-1991	JP 1887127 C JP 6017646 B	22-11-1994 09-03-1994
WO 0076637	A	21-12-2000	NL 1012296 C2 AU 5579600 A CA 2374647 A1 CN 1355721 T EP 1204458 A1 JP 2003530982 T WO 0076637 A1	12-12-2000 02-01-2001 21-12-2000 26-06-2002 15-05-2002 21-10-2003 21-12-2000
US 2002073692	A1	20-06-2002	JP 2002188431 A DE 10142397 A1	05-07-2002 27-06-2002
EP 0773354	A	14-05-1997	JP 9133032 A DE 69616235 D1 DE 69616235 T2 EP 0773354 A1 US 5782087 A	20-05-1997 29-11-2001 27-06-2002 14-05-1997 21-07-1998
WO 03009925	A	06-02-2003	DE 10135646 A1 WO 03009925 A1	06-02-2003 06-02-2003
DE 19510804	A	26-09-1996	DE 19510804 A1	26-09-1996
WO 0114698	A	01-03-2001	US 6560958 B1 CA 2383551 A1 EP 1212520 A1 JP 2003529012 T WO 0114698 A1 US 2002194835 A1	13-05-2003 01-03-2001 12-06-2002 30-09-2003 01-03-2001 26-12-2002